REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED	1b. RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY	3 DISTRIBUTION / AVAILABILITY OF REPORT Approved for public release; distribution is unlimited.
2b DECLASSIFICATION / DOWNGRADING SCHEDULE	
4 PERFORMING ORGANIZATION REPORT NUMBER(S) NPRDC TR 87-6	5. MONITORING ORGANIZATION REPORT NUMBER(S)
6a NAME OF PERFORMING ORGANIZATION Navy Personnel Research and Development Center 6b OFFICE SYMBOL (*If applicable*) Code 61	7a. NAME OF MONITORING ORGANIZATION
6c ADDRESS (*City, State, and ZIP Code*) San Diego, CA 92152-6800	7b. ADDRESS (*City, State, and ZIP Code*)
8a. NAME OF FUNDING / SPONSORING Recruiting Service Marine Corps Headquarters 8b OFFICE SYMBOL (*If applicable*) MPI-40	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER
8c ADDRESS (*City, State, and ZIP Code*) Navy Annex Washington, DC	10 SOURCE OF FUNDING NUMBERS PROGRAM ELEMENT NO: 63732M PROJECT NO: C0073 TASK NO.: 01.02 WORK UNIT ACCESSION NO:

11 TITLE (*Include Security Classification*)
A DECISION MODEL TO IMPROVE THE ASSIGNMENT OF ENLISTMENT PROGRAM GUARANTEES IN THE MARINE CORPS

12 PERSONAL AUTHOR(S)
Buclatin, Ben

13a. TYPE OF REPORT	13b TIME COVERED	14 DATE OF REPORT (*Year, Month, Day*)	15 PAGE COUNT
	FROM 85 Jan TO 86 Jan	1986 October	16

16 SUPPLEMENTARY NOTATION
See NPRDC TR 84-86 and 85-18 for related information about minority fill and program fill.

17 COSATI CODES		
FIELD	GROUP	SUB-GROUP
05	09	

18 SUBJECT TERMS (*Continue on reverse if necessary and identify by block number*)
Enlistment program guarantees, personnel classification, optimal assignment, personnel assignment, recruit classification, recruiting

19 ABSTRACT (*Continue on reverse if necessary and identify by block number*)

The report discusses the overall approach and design of a method for improving the assignment of Marine Corps enlistment program guarantees to recruit applicants. The manpower policies are quantified in an optimization model that allows for flexible prioritization. The decision model generates recommendations based on eligibility criteria and policy priorities. The resulting recommendations provide the recruiters with a tool to help them make decisions consistent with Marine Corps policies.

20 DISTRIBUTION / AVAILABILITY OF ABSTRACT ☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT ☐ DTIC USERS	21. ABSTRACT SECURITY CLASSIFICATION UNCLASSIFIED
22a NAME OF RESPONSIBLE INDIVIDUAL Buclatin, Ben	22b TELEPHONE (*Include Area Code*) (619) 225-2371 22c. OFFICE SYMBOL Code 61

DD FORM 1473, 84 MAR 83 APR edition may be used until exhausted
All other editions are obsolete

NPRDC-TR-87-6

OCTOBER 1986

A DECISION MODEL TO IMPROVE THE ASSIGNMENT OF ENLISTMENT PROGRAM GUARANTEES IN THE MARINE CORPS

NAVY PERSONNEL RESEARCH
AND
DEVELOPMENT CENTER
San Diego, California 92152

NPRDC TR 87-6

October 1986

A DECISION MODEL TO IMPROVE THE ASSIGNMENT OF ENLISTMENT PROGRAM GUARANTEES IN THE MARINE CORPS

Ben Buclatin

Reviewed by
Joe Silverman

Approved by
Martin F. Wiskoff

Released by
B. E. Bacon
Captain, U.S. Navy
Commanding Officer

Navy Personnel Research and Development Center
San Diego, California 92152-6800

FOREWORD

This research and development was conducted within advanced development task C0073-02 (USMC Optimal Enlistment Guarantees), under the mission sponsorship of the United States Marine Corps. The objective of the project is to design and develop an automated system to improve execution of Marine Corps Headquarters Recruiting Service policies through better assignment of the enlistment program guarantees.

This report is the third in a series resulting from this project. Previous reports identified and quantified two recruiting policies: minority and program fill rates (NPRDC TRs 84-46 and 85-18). This report documents the overall design and approach of a new prototype. The results should be of interest to managers and recruiters within the Marine Corps Recruiting Service and Department of Defense researchers involved in developing personnel allocation systems.

We acknowledge John Folchi for his early involvement in this project.

B. E. BACON
Captain, U.S. Navy
Commanding Officer

JAMES E. TWEEDDALE
Technical Director

SUMMARY

Problem

Marine Corps recruiters currently assign recruit applicants to enlistment programs using a manual pencil-and-tally method. The decision guidelines used vary from recruiter to recruiter, from case to case, and from period to period. With multiple and sometimes conflicting policy goals to be considered, decision makers are unable to satisfy all policy requirements or make consistent decisions. An automated system is needed to provide recruiters with recommendations that reflect accurate and consistent execution of the policy objectives.

Objective

The objective of this research was to develop an automated system that provides recommendations of enlistment program guarantees based on a prioritized set of policies.

Approach

Eligibility criteria for all enlistment program options were programmed into a computer system. Based on an eligibility file, consisting of all enlistment program options for which an applicant is qualified, the system then rank orders program options based on the relative priorities of policy objectives. The output of the automated system displays the top-ranked enlistment program options.

Results and Discussion

The automated system provides the capability of recommending enlistment program guarantees based on a prioritized list of policies. The reports generated by the system show the top-ranked enlistment program guarantees with a detailed computer screen display of the corresponding policy data. The system allows users to manipulate the relative importance of the policy objectives and to view the resulting recommendations. The system could be incorporated within the Automated Recruit Management System (ARMS) to improve its operational efficiency and provide a consistent procedure for executing multiple policies for assigning enlistment program guarantees.

Future Development

The Marine Corps recruiting managers recognize the benefits of expanding the prototype into a working, operational model. Several alternatives are being considered. In one alternative, running the model on existing microcomputers can provide recruiters with an early opportunity to use the model, but a disadvantage of this approach is the administrative effort required to ensure that the files and programs are kept current. Furthermore, this microcomputer approach does not allow central updating and access to real-time data. Another alternative would be to incorporate the model within the ARMS. Because of limited user terminals and computer capacity, this latter alternative is not currently feasible. A more likely strategy would use both alternatives in a two-stage approach--running the model on microcomputers in the short term, and then migrating the model to ARMS when hardware and computing capacity become available.

CONTENTS

LIST OF FIGURES

INTRODUCTION

Problem

To attract desirable individuals into the Marine Corps, recruiters offer some recruit applicants enlistment program guarantees. Before offering a recruit applicant an enlistment program guarantee, a preliminary screening process is required to find those programs for which he or she is qualified. Because each enlistment program has specific mental, physical, and moral eligibility criteria, a recruit applicant may not qualify for every enlistment program option. Nevertheless, in many cases, a recruit applicant is eligible for dozens of programs, making it difficult and time-consuming to manually identify all of these opportunities. In addition, recruiters must consider individual preferences and multiple Marine Corps recruit assignment policies to select the best program guarantees for the recruit applicant and the Marine Corps.

Because of the manual nature of the current guarantee system, human limitations in considering all program options, and multiple assignment policies, the decision process varies from one recruiter to another, from one week to another, and from one applicant to another. This inconsistency in the decision process makes policy goals difficult to achieve.

An automated system is needed to quickly and accurately identify all program guarantees for which an individual recruit applicant is eligible, and to systematically and effectively select the best program options based on individual preferences and Marine Corps policies.

Objective

The objective of this research project was the development of an automated system that provides recommendations of enlistment program guarantees based on a prioritized list of policies.

APPROACH

Development Strategy

Strong competition with other military services for high-quality individuals requires Marine Corps recruiters to assign enlistment program guarantees to recruit applicants on a first-come, first-served basis. Each recruiting station is allocated a quota of guarantees for each enlistment program. In a first-come, first-served environment, the decision process is not as likely to match enlistment program guarantees to people as well as when many candidates are considered simultaneously. However, at any given time, the enlistment program guarantee recommendations should be consistent with the applicant's preferences and the Marine Corps' objectives.

Automated recruit classification and program recommendation systems for a first-come, first-served environment have been developed by the Air Force and the Navy. The Air Force's Advanced Personnel Data System's Procurement Management Information System (Ward, Haney, Hendrix, & Pina, 1978) sequentially classifies recruit applicants according to their test and interview results. The Navy followed the Air Force's effort with their own classification model, Classification and Assignment Within PRIDE (CLASP; Kroeker & Rafacz, 1983). The Navy's and the Air Force's models contain utility functions

for individual preferences and multiple policy objectives, and they handle policy trade-offs through the use of a composite utility function. The Marine Corps' earlier efforts concentrated on developing the utility functions for the minority fill (Kroeker & Folchi, 1984) and the program fill (Kroeker & Folchi, 1985) policies. The recruiting managers later reviewed and eliminated the minority fill component from the model. The fundamental idea of the program fill utility function has been incorporated in the current model.

In developing a system for the Marine Corps, we used a two-step approach. First, we developed an eligibility module that identifies enlistment programs for which an individual is eligible. Then we developed a module to rank order these enlistment program options according to the policy objectives.

System Overview

Figure 1 illustrates the major functional steps of the system we developed for the Marine Corps. After the data are entered, the system determines all programs for which a candidate qualifies. This step involves screening applicant profile data against the minimum qualification criteria of each enlistment program. An eligibility file containing all enlistment programs for that candidate is created from this step. The ordering module uses this eligibility file in conjunction with a policy file to generate output containing 10 top-ranked enlistment program guarantees. The major steps can be summarized as follows:

- Data input.
- Determination of enlistment program options for which the applicant is eligible.
- Ordering of options based on Marine Corps policies.
- Output report

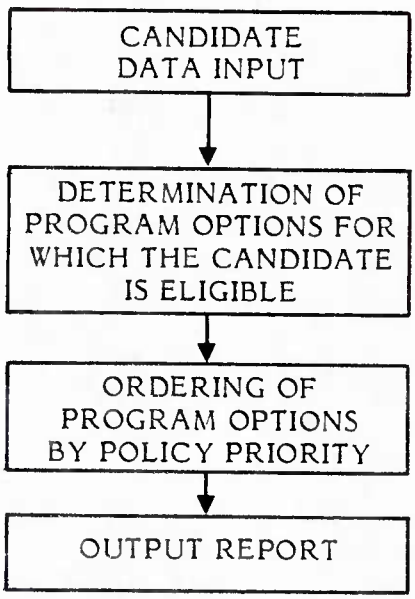

Figure 1. Overview of the major steps for ranking enlistment program options.

Determination of Eligible Program Options

In the prototype system, the applicant profile data are interactively input to the system. The major classes of data requested by the system include physical attributes, individual preferences, and aptitude scores. (Table 1 lists the data elements prompted by the system.)

Table 1

Applicant Profile

Data Elements for Interactive Input	
Social Security Number	Education Level
Begin Ship Date	Date of Birth
End Ship Date	Left Uncorrected Vision
1st Preference	Right Uncorrected Vision
2nd Preference	Left Corrected Vision
3rd Preference	Right Corrected Vision
4th Preference	GT Score
5th Preference	GM Score
Citizen (C/N)	EL Score
Color Perception (P/N)	CL Score
Sex (M/F)	MM Score
Driver's License (Y/N)	EDPT Score
Height	CO Score
Weight	FA Score
Enlistment Term	

The system then creates a file containing all enlistment programs for which an applicant qualifies. Table 2 shows the data elements of the system's qualifications file, which contains the minimum qualifications for each program. The system identifies all programs for which the applicant qualifies by using the applicant profile data. The resulting eligibility file is then used by the ordering module.

Table 2

Data Elements of the Qualifications File

Data Elements for Each Enlistment Guarantee Program	
Program Code	Sex (M/F)
Number of ASVAB Composites	Left Uncorrected Vision
Minimum Composite Flag	Right Uncorrected Vision
Eligibility Indicator	Left Corrected Vision
Minimum Qualifications Score	Right Corrected Vision
Minimum Enlistment Period	High School Graduate (Y/N)
Color Perception (P/N)	Minimum Height
Citizenship (C/N)	Driver's License (Y/N)
Minimum Age	

Ordering of Program Options

A fundamental requirement of the system was the ability to incorporate specific policy objectives. In developing this model, the policy objectives were identified, quantified, and integrated to allow flexible prioritization.

The concept of an optimal assignment is a function of the policies and their relative priorities. For example, the recommended enlistment guarantee under the policy of maximizing individual preference may not be the best recommendation under the policy of uniformly filling the different programs. In the current environment, the Marine Corps is faced with multiple policies and therefore, the optimal enlistment program guarantee will depend not only on the policies, but also on their relative weights. We observed that Marine Corps decisions in an environment of multiple policies are made in a preemptive manner. Therefore, in selecting an ordering methodology, the rank-ordering procedure was chosen because it is a preemptive technique that is simple to understand and easy to implement.

The prototype system assigns weights to the policies in a preemptive manner. That is, the first policy performs a first-pass ordering of the enlistment program options. The second policy orders those enlistment program options that were ranked equally by the first policy. Similarly, the third policy orders those enlistment program options that were ranked equally by the second policy. This ranking process continues for each policy.

The following four policy objectives were identified as a result of discussion with users from Marine Corps Recruiting Service:

1. Maximizing individual preference.
2. Matching job complexity with applicant aptitude.
3. Filling programs at a uniform rate.
4. Filling shipping months at a uniform rate.

Maximizing Individual Preference

Satisfying a recruit applicant's career desires is an important Marine Corps policy. The opportunity to fulfill training and career goals can be an attractive incentive to individuals contemplating joining the Marine Corps. As part of the input process, an applicant must specify his top five preferences. When rank ordering by individual preference, the applicant's first preferred enlistment program will be ranked first, the second preferred enlistment program will be ranked second, etc.

Matching Job Complexity With Applicant Aptitude

Enlistment program guarantees require minimum aptitude "cutoff" scores for eligibility; with programs in technical occupational areas generally requiring higher scores. Because of continuing manpower shortages in the technical jobs, a valuable match occurs when a high-aptitude applicant is assigned a high-tech enlistment program guarantee. This assignment is considered more valuable than assigning a high-aptitude applicant to a low-complexity enlistment program guarantee or assigning a low-aptitude individual to a low-complexity job.

The ranking of enlistment program guarantees based on aptitude/complexity is a two-step process. In the first step, all enlistment program options for which the applicant qualifies are ranked by the minimum aptitude cutoff scores--the highest minimum score ranks first. In the second step, enlistment program options having the same cutoff score are ranked by the amount that the aptitude score exceeds the cutoff score--the smallest difference ranks highest.

Filling Programs at a Uniform Rate

Maintaining adequate personnel in the various occupational areas is important in achieving personnel readiness. Frequently, there are job programs that are unable to attract sufficient qualified applicants. The shortage may result from a low influx of applicants to the programs, expansion of billets, a low reenlistment rate, or a combination of the above factors. The Marine Corps can achieve a better utilization of its enlistment programs by guiding qualified applicants into enlistment programs which are underutilized.

This policy is aimed at recommending those enlistment program guarantees with the lowest percentage fills. Enlistment program options with the lowest percentage fills are ranked the highest (No. 1 recommendation), and those with the highest percentage fills are ranked the lowest.

Filling Shipping Months at a Uniform Rate

School seats are made available to recruit applicants throughout the year. Normally, training resources are planned long before they actually become available. Whenever school seats go unfilled during a month, training resources are wasted. On the other hand, overutilization of school seats during a given month degrades the quality of training. The Marine Corps can achieve a better utilization of its training resources throughout the year by influencing recruits to start training during slack shipping months.[1]

---

[1] The shipping month is the calendar month when the applicant is scheduled to begin training.

Enlistment program options are ranked according to shipping-month fill rates. Enlistment program options in shipping months with the lowest fill rates are ranked the highest.

Numerical Example

Figure 2 illustrates a preliminary ranking of enlistment options by their payoffs for three policies. The payoffs of the program options are different for each policy. The example shows that the most suitable recommendation under Policy A alone is Program ZD since it has the highest payoff (10). However, under Policy B alone, Program AA has the highest payoff. Under Policy C alone, Program AC is the most suitable route to implementation.

Eventual Policy Priority

1. Policy A
2. Policy B
3. Policy C

Program	Policy A	Policy B	Policy C
ZD	10	8	2
AA	9	10	7
G2	9	5	8
ZE	7	9	9
ZK	6	7	2
ZH	6	7	1
AC	5	8	10
ZF	5	8	7
AD	5	8	5
G7	5	4	9

Figure 2. Numerical example of rank ordering of enlistment options by payoff for three separate policies. Ten (10) indicates a high payoff.

The actual ranking of the enlistment program options depends on the priorities of Policies A, B, and C. In this example, Policy A is the Marine Corps' highest priority, so the enlistment program options are ranked first by this policy. As a result of ranking by Policy A, three sets of ties occurred--between AA and G2, between ZK and ZH, and among AC, ZF, AD, and G7. In the event of ties, Policy B, the next most important policy for this example, orders enlistment programs within the tied groups. In the first tied group, AA is ranked higher than G2 because it has a higher payoff under Policy B. In the

second tied group, both ZK and ZH have the same payoff under Policy B, and therefore Policy C is used as the tie breaker. In the third tied group, GZ has a lower payoff than AC, ZF, and AD under Policy B, and is therefore ranked lowest. Program AC, ZF, and AD have the same payoff under Policy B, so Policy C is used to rank these three options.

RESULTS AND DISCUSSION

Computer software was developed so that the prototype could operate as a stand-alone application on the Navy Personnel Research and Development Center's IBM 4341 computer. The Fortran language was used for all the software programs. The model was designed to allow easy modifications. As a result, users can quickly see the effect from recommendations they make from reviewing and testing the software.

The model identifies all eligible program options and rank orders these options based on individual preferences and Marine Corps recruit assignment policy. Figure 3 is an example of the results based on four policies. In this example, matching aptitude to job complexity is the most important policy, followed by level program-fill rate, maximizing individual preference, and level shipping-month fill rate. These policies are listed on the top of the figure in the order of their relative importance. The recommended enlistment program options are listed below the policies. A program is identified uniquely by a combination of the program code (e.g., ZH, ZJ) and the shipping month (e.g., SEP 85).

Figure 3 displays the screen of detailed policy data. The policy priority determine the ranking of the enlistment program options. Since matching aptitude to job complexity (APT/COMP) is the highest ranked policy, this policy performs the first-pass rank ordering. The APT/COMP policy ranks enlistment program options in two steps. Since enlistment programs ZF and G2 have the highest program complexities (highest minimum required cutoff score), these two enlistment program options are ranked the highest. Enlistment program ZF SEP 85 is ranked higher than G2 AUG 85 because the aptitude score for ZF is closer to the minimum cutoff score than the aptitude score for G2.

Enlistment programs ZD AUG 85 and ZD SEP 85 are ranked equally by the APT/COMP policy since they both have the same aptitude and complexity scores. The effects of the other policies have to be examined to determine how to rank these tied enlistment program options. The second policy, program-fill percentage (PROG FILL) again ranks ZD AUG 85 and ZD SEP 85 equally since both have the same fill percentages. The third policy, individual preference, ranks these two policies equally. Finally, the shipping-month policy (MONTH FILL) ranks ZD AUG 85 higher than ZD SEP 85 because of the lower shipping-month percentage.

Enlistment program options ZH SEP 85 and ZH AUG 85 are ranked equally by the APT/COMP and PROG FILL policy. However, the MONTH FILL policy ranked ZH SEP 85 higher than ZH AUG 85 because of the lower fill percentage.

Figure 4 illustrates an example where the same three policies are prioritized in a different sequence. Given the same recruit applicant, the recommendations under this scenario are different than those made in the previous case.

The existing manual method of assigning enlistment guarantees is time-consuming and does not consistently or adequately consider multiple policy objectives in the assigning of enlistment program guarantees to recruit applicants. This research effort developed an automated system to improve the efficiency and effectiveness of the

Policy Priority Sequence

1. Matching aptitude to job complexity.
2. Level program fill rate.
3. Maximizing individual preference.
4. Level shipping month fill rate.

Your best opportunities to serve the United States Marine Corps are:

SELECTION NO.	PRGM GUAR	SHIP MONTH	APT/ COMP	PROG FILL (%)	PREF PAY	MONTH FILL (%)
1	ZF	SEP 85	140/100	52	3	25
2	G2	AUG 85	145/100	75		34
3	ZD	SEP 85	155/98	51		25
4	ZD	AUG 85	155/98	51		34
5	ZH	SEP 85	155/90	31	1	25
6	ZH	AUG 85	155/90	31	1	34
7	G7	SEP 85	145/85	78		25
8	G7	AUG 85	145/85	79		34
9	ZJ	SEP 85	145/80	42	2	25
10	ZJ	AUG 85	145/80	42	2	34

Figure 3. Computer screen display of optimal recommendations: Case I.

Policy Priority Sequence

1. Matching individual preference.
2. Level program fill rate.
3. Level shipping month fill rate.

Your best opportunities to serve the United States Marine Corps are:

SELECTION NO.	PRGM GUAR	SHIP MONTH	PREF PAY	PROG FILL (%)	MONTH FILL (%)
1	ZD	SEP 85	1	24	13
2	ZD	AUG 85	1	24	26
3	ZD	OCT 85	1	24	39
4	ZE	SEP 85	2	52	13
5	ZE	AUG 85	2	52	26
6	ZE	OCT 85	2	52	39
7	ZF	SEP 85		12	13
8	ZK	AUG 85		12	26
9	G7	AUG 85		16	26
10	ZH	SEP 85		21	13

Figure 4. Computer screen display of optimal recommendations: Case II.

current decision process. The results under different policy priorities illustrate how the policy order affects the optimal recommendation. Although developed as a stand-alone model, it could be converted to operate as a module within the Automated Recruit Management System (ARMS). This would not only improve operational efficiency, but would provide a consistent methodology for executing multiple policies.

FUTURE DEVELOPMENT

The Marine Corps recruiting managers have recognized the potential benefits of expanding the prototype into an operational model. Currently, methods of implementing the model are being investigated by the systems and recruiting managers. One alternative would be to have the model operating on microcomputers in various recruiting stations or substations. A disadvantage of this alternative is the tremendous administrative effort required to ensure that users have the most current versions of the files and programs. In addition, this alternative does not allow central updating and access to real-time data. Another strategy would be to incorporate the model within the ARMS system. The problem with this latter alternative is that the current ARMS system does not have the computer capacity nor the user terminals to provide each recruiter with access to the model. A comprehensive implementation strategy may be to first use the model on microcomputers and later, when the hardware and computer capacity become available, migrate the model to the ARMS system.

REFERENCES

Kroeker, L. P., & Folchi, J. (1984, July). Minority fill-rate component for Marine Corps recruit classification: Development and test (NPRDC Tech. Rep. 84-46). San Diego: Navy Personnel Research and Development Center. (AD-A143 893)

Kroeker, L. P., & Folchi, J. (1985, January). Marine Corps recruit classification: The program fill component (NPRDC Tech. Rep. 85-18). San Diego: Navy Personnel Research and Development Center. (AD-A150 041)

Kroeker, L. P., & Rafacz, B. A. (1983, November). Classification and assignment within PRIDE (CLASP): A recruit assignment model (NPRDC Tech. Rep. 84-9). San Diego: Navy Personnel Research and Development Center. (AD-A136 907)

Ward, J. H., Haney, D. L., Hendrix, W. H., & Pina, M. (1978, July). Assignment procedures in the Air Force Procurement Management Information System (AFHRL Tech. Rep. 78-30). Brooks Air Force Base, TX: Air Force Human Resources Laboratory.

DISTRIBUTION LIST

Chief of Naval Operations (OP-01B7) (2), (OP-987H)
Director of Navy Laboratories (ONT 0722)
Chief of Naval Research (Code 270)
Commandant of the Marine Corps (MPI-20), (MPI-40) (5), (MRRE) (5)
Commander, Air Force Human Resources Laboratory, Brooks Air Force Base (TSRL/Technical Library FL 2870)
Director of Research, U.S. Naval Academy
Canadian Forces Personnel, Applied Research Unit, Canada
D. Dennison, Army Personnel Research Establishment, Personnel Psychological Division, England (2)
Science 3 (RAF), Lacon House, England
1 Psychological Research Unit, NBH 3-44, Australia
Navy Psychology, Australia (2)
Defense Psychology Unit, Defense HQ, New Zeland (2)
Defense Technical Information Center (DDAC) (2)

DEPARTMENT OF THE NAVY
NAVY PERSONNEL RESEARCH AND
DEVELOPMENT CENTER
(CODE___)
SAN DIEGO, CA 92152-6800

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE, $300

POSTAGE AND FEES PAID
DEPARTMENT OF THE NAVY
DoD-316

U.S.MAIL

SUPERINTENDENT
NAVAL POSTGRADUATE SCHOOL
MONTEREY, CA 93943-5100

0142